4K93-22

# An Analysis of Two Counting Methods Used For Estimates During The First Hour For Chinook and Sockeye Escapements Through The Chignik Weir, 1992

By

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## INTRODUCTION

A study was conducted at the Chignik River weir during the 1992 salmon season to evaluate the accuracy of two counting and expansion methods that estimate the sockeye and chinook salmon escapement during the first opening hour (7:00 - 8:00 am). In previous years, total hourly counts were estimated daily from 7:00 am to 10:00 pm (gates close at 10:00 pm) using the same methodology: counts were taken at 10 minute intervals beginning on the hour, at two gates, and expanded to the hour. However, a study conducted during the first hour in 1991, with only five data points, suggested that actual sockeye numbers were 50% less than the estimated numbers. Other counts throughout the day were assumed to have little, if any, bias.

## METHODS

The study compared two counting and estimating methods for the first hour counts. The method used in previous years (old method), expanded 10 minute counts at two gates by a factor of six at the beginning of the hour (Gate 1: 7:00-7:10 am, Gate 2: 7:10-7:20 am) to estimate total counts for the first hour. The second method, used this year (new method), tallied actual counts for the first 20 minutes (7:00 - 7:20 am) and for 10 minutes at the half-hour (7:30 - 7:40 am) at two gates. The counts between 7:20 - 7:30 am and 7:40 - 8:00 am were estimated by linear interpolation. The total estimated escapement for the 7:00 am - 8:00 am period was a sum of the actual counts and linear interpolated values as calculated by a Lotus Spreadsheet developed by Bruce Barrett, Westward Regional Research Biologist (Appendix A.1).

To determine the amount of error in both methods, actual counts were taken from 7:00 - 8:00 am and summarized at five minute intervals at each gate and compared to results from the old and new method estimates.

## RESULTS

A total of 38 and 13 actual counts for sockeye and chinook salmon were recorded (Tables 1 and 2) and summarized at 5 minute intervals during the first hour of the study (Table 3). The decrease during the first hour was linear for both sockeye and chinook salmon, but the slope of the line for chinook salmon was steeper than that for sockeye salmon (Table 3 and Figure 1). For sockeye salmon, 22.7% of the total hour count passed through the weir in the first 10 minutes and 20.6% in the next 10 minutes for a total of 43.3% in the first 20 minutes. While for chinook salmon, 33.1% of the total hour count passed through the weir in the first 10 minutes and 25.9% in the next 10 minutes for a total of 59.0% in the first 20 minutes. On a seasonal basis, the first hour counts represented 15% of the total sockeye (Figure 2) and 23% of the total chinook salmon escapement (Figure 3) counted for the entire day.

Actual counts (38) that were compared to estimates for each method by day for sockeye salmon, showed that the old method's estimates contained a more continuous positive bias (average 36.3%, range 600% to - 100%) than the new method (average -1.9%, range .1% to 54.5%) (Table 4 and Figure 4). However, both methods exhibited a positive bias at low counts, but more extemely so for the old method where the percent error was large and variable at sample counts less than 1000 but leveled off with greater sample sizes (Figure 5). Only in six of the 38 instances was the old method closer to actual values than the new method. Four of the six coincided with a flooding tide.

A total of 13 full hour escapement counts that were compared to escapement estimates generated for each method by day for chinook salmon showed that the estimates derived by the old method contained a continuous positive bias (average 98.9%, range 380% to 15.4%) whereas the estimate obtained by the new method were both positive and negative with the overall being slightly positive (0.6%, range 0.0% to 150%) (Table 5 and Figure 6).

The overall difference for sockeye salmon between actual counts and estimates by the two methodologies was expanded first to both gates during the sampling period and than to the entire season. An adjustment was made for expansions made by the old method because the escapement declined throughout the first hour and counts were always made at one gate at a time. Since the second actual ten minute sample was on average less than the first ten minute count, the expansion for the old method was lessened by this amount (2.1%). The old method would overestimate the 1992 sockeye salmon salmon escapement by 38,316 (5.0% error) while the new method would underestimate by 2,026 (-0.3% error) (Tables 6 and 7).

The overall difference for chinook salmon between actual counts and estimates by the two methodologies was first expanded to both gates then to the entire season. After the first hour, chinook salmon for both gates was totaled but not recorded by gate. Since chinook salmon were as likely to go through either gate (Table 8), sampled gate counts were doubled to estimate total counts for the two gates. Also, the second ten minute sample was lessened by 7.2% to account for the decreasing escapement rates between the first ten minute count and the second. The old method would overestimate the 1992 chinook escapement by 1,502 (41.0% error) while the new method would overestimate by 5 (0.1% error)(Tables 7 and 9).

## CONCLUSION

The new method of counting 30 minutes in the first hour, interpolating between counted points, and averaging at each gate produced much less error than the old method of multiplying the 10 minute counts by six (Tables 6-8). The new method appears to perform adequately, and its continued use is highly recommended. The percent error that apparently existed with the old method for chinook salmon is high considering minimum escapement values of approximately 1,800 fish.

Table 1. Sockeye salmon escapement counts (n=38) by sample date at gates 1 and 2, recorded at 5 minute intervals, during the 7:00 - 8:00 am period, Chignik River weir, 1992.

| | Gate 1 | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 6/16 | 6/18 | 6/19 | 6/20 | 6/21 | 6/22 | 6/23 | 6/24 | 6/25 | 6/26 | 6/28 | 6/29 | 6/30 | 7/1 | 7/2 | 7/3 | 7/5 | 7/13 | 7/14 | 7/15 | 7/16 |
| Time | | | | | | | | | | | | | | | | | | | | | |
| 7:05 | 212 | 12 | 10 | 6 | 110 | 205 | 253 | 445 | 464 | 10 | 4 | 8 | 5 | 13 | 3 | 7 | 3 | 46 | 115 | 106 | 160 |
| 7:10 | 226 | 6 | 1 | 5 | 130 | 208 | 322 | 457 | 372 | 9 | 0 | 3 | 2 | 10 | 1 | 3 | 1 | 88 | 110 | 64 | 151 |
| 7:15 | 181 | 1 | 2 | 1 | 125 | 180 | 253 | 425 | 323 | 0 | 1 | 0 | 1 | 1 | 0 | 14 | 0 | 92 | 89 | 53 | 124 |
| 7:20 | 176 | 3 | 7 | 2 | 125 | 258 | 244 | 412 | 316 | 1 | 0 | 1 | 1 | 6 | 1 | 10 | 0 | 77 | 19 | 50 | 104 |
| 7:25 | 130 | 0 | 0 | 0 | 110 | 245 | 344 | 397 | 304 | 3 | 0 | 2 | 6 | 2 | 0 | 3 | 0 | 69 | 18 | 17 | 141 |
| 7:30 | 115 | 0 | 0 | 2 | 161 | 239 | 330 | 260 | 356 | 0 | 1 | 3 | 4 | 0 | 1 | 6 | 0 | 71 | 10 | 30 | 72 |
| 7:35 | 120 | 0 | 2 | 0 | 160 | 173 | 265 | 330 | 255 | 1 | 1 | 1 | 3 | 4 | 3 | 0 | 0 | 55 | 28 | 20 | 62 |
| 7:40 | 120 | 0 | 0 | 2 | 110 | 156 | 216 | 319 | 253 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 45 | 16 | 27 | 121 |
| 7:45 | 95 | 0 | 0 | 0 | 68 | 166 | 339 | 345 | 202 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 19 | 16 | 18 | 115 |
| 7:50 | 140 | 1 | 0 | 0 | 60 | 172 | 312 | 328 | 204 | 0 | 0 | 0 | 1 | 0 | 0 | 7 | 0 | 31 | 24 | 23 | 51 |
| 7:55 | 134 | 0 | 0 | 0 | 136 | 164 | 337 | 323 | 180 | 1 | 0 | 1 | 1 | 0 | 0 | 9 | 0 | 2 | 14 | 13 | 67 |
| 8:00 | 92 | 0 | 1 | 3 | 64 | 167 | 239 | 352 | 163 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 2 | 23 | 5 | 86 |
| Total | 1,741 | 23 | 23 | 21 | 1,359 | 2,333 | 3,454 | 4,393 | 3,392 | 27 | 8 | 21 | 24 | 38 | 11 | 60 | 5 | 597 | 482 | 426 | 1,254 |

| | Gate 1 | | | | | | | Gate 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 7/17 | 7/18 | 7/19 | 7/20 | 7/21 | 7/22 | 7/24 | 7/25 | 7/26 | 7/27 | 7/28 | 7/29 | 7/30 | 7/31 | 8/1 | 8/2 | 8/3 | Total |
| Time | | | | | | | | | | | | | | | | | | |
| 7:05 | 65 | 227 | 150 | 10 | 85 | 36 | 238 | 176 | 173 | 144 | 103 | 117 | 132 | 21 | 1 | 12 | 19 | 3,906 |
| 7:10 | 113 | 149 | 142 | 60 | 134 | 99 | 335 | 116 | 117 | 127 | 57 | 139 | 162 | 15 | 2 | 7 | 24 | 3,967 |
| 7:15 | 52 | 165 | 99 | 24 | 84 | 105 | 228 | 223 | 97 | 232 | 78 | 172 | 124 | 9 | 8 | 10 | 16 | 3,592 |
| 7:20 | 139 | 159 | 81 | 11 | 49 | 101 | 407 | 182 | 92 | 144 | 67 | 165 | 53 | 34 | 10 | 11 | 31 | 3,549 |
| 7:25 | 194 | 128 | 113 | 14 | 74 | 69 | 224 | 184 | 107 | 101 | 60 | 39 | 123 | 25 | 9 | 9 | 9 | 3,273 |
| 7:30 | 130 | 157 | 71 | 9 | 69 | 68 | 240 | 89 | 66 | 119 | 68 | 148 | 125 | 19 | 8 | 16 | 8 | 3,071 |
| 7:35 | 75 | 149 | 85 | 9 | 24 | 56 | 137 | 98 | 25 | 82 | 27 | 67 | 57 | 11 | 4 | 7 | 12 | 2,408 |
| 7:40 | 92 | 129 | 79 | 5 | 17 | 53 | 130 | 136 | 49 | 67 | 25 | 12 | 83 | 4 | 7 | 12 | 6 | 2,295 |
| 7:45 | 130 | 98 | 38 | 1 | 34 | 38 | 107 | 132 | 39 | 43 | 25 | 26 | 43 | 11 | 15 | 3 | 8 | 2,176 |
| 7:50 | 50 | 243 | 61 | 2 | 42 | 43 | 125 | 71 | 26 | 34 | 5 | 3 | 8 | 7 | 8 | 11 | 9 | 2,102 |
| 7:55 | 76 | 120 | 160 | 4 | 24 | 38 | 123 | 154 | 63 | 61 | 16 | 16 | 10 | 3 | 10 | 18 | 6 | 2,284 |
| 8:00 | 146 | 146 | 75 | 2 | 36 | 31 | 97 | 157 | 38 | 39 | 1 | 3 | 25 | 9 | 14 | 8 | 6 | 2,035 |
| Total | 1,262 | 1,870 | 1,154 | 151 | 672 | 737 | 2,391 | 1,718 | 892 | 1,193 | 532 | 907 | 945 | 168 | 96 | 124 | 154 | 34,658 |

Table 2. Chinook salmon escapement counts (n=13) by sample date at gates 1 and 2, recorded at 5 minute intervals, during the 7:00 - 8:00 am period, Chignik River weir, 1992.

| | Gates 1 and 2 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 7/18 | 7/19 | 7/22 | 7/21 | 7/24 | 7/26 | 7/27 | 7/28 | 7/29 | 7/30 | 7/31 | 8/1 | 8/3 | Total |
| Time | | | | | | | | | | | | | | |
| 7:05 | 3 | 0 | 1 | 4 | 7 | 2 | 1 | 2 | 2 | 3 | 3 | 1 | 2 | 31 |
| 7:10 | 4 | 2 | 1 | 3 | 3 | 3 | 5 | 1 | 4 | 1 | 1 | 1 | 0 | 29 |
| 7:15 | 3 | 1 | 2 | 1 | 3 | 6 | 5 | 1 | 1 | 0 | 3 | 0 | 1 | 27 |
| 7:20 | 3 | 0 | 1 | 0 | 4 | 1 | 5 | 1 | 3 | 0 | 1 | 1 | 0 | 20 |
| 7:25 | 3 | 0 | 0 | 1 | 6 | 3 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 17 |
| 7:30 | 4 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 15 |
| 7:35 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 6 |
| 7:40 | 0 | 1 | 0 | 1 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 7:45 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 10 |
| 7:50 | 1 | 0 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 7:55 | 1 | 0 | 0 | 0 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 8:00 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 |
| Total | 24 | 4 | 5 | 12 | 44 | 26 | 21 | 7 | 15 | 5 | 9 | 4 | 5 | 181 |

Table 3. Total sockeye and chinook salmon escapement counts at gates 1 and 2, recorded at 5 minute intervals, during the 7:00 -8:00 am period where n=38 for sockeye and n=13 for chinook, Chignik River weir, 1992.

| | Sockeye | | | | | | Chinook | |
|---|---|---|---|---|---|---|---|---|
| | Gate 1 | | Gate 2 | | Total Counts 1 & 2 | | | |
| Time Intervals | Actual Count | Percent Of Total Count | Actual Count | Percent Of Total Count | Actual Count | Percent Of Total Count | Actual Count | Percent Of Total Count |
| 7:05 | 2,770 | 10.8 | 1,136 | 12.5 | 3,906 | 11.3 | 31 | 17.1 |
| 7:10 | 2,866 | 11.2 | 1,101 | 12.1 | 3,967 | 11.4 | 29 | 16.0 |
| 7:15 | 2,395 | 9.4 | 1,197 | 13.1 | 3,592 | 10.4 | 27 | 14.9 |
| 7:20 | 2,353 | 9.2 | 1,196 | 13.1 | 3,549 | 10.2 | 20 | 11.0 |
| 7:25 | 2,383 | 9.3 | 890 | 9.8 | 3,273 | 9.4 | 17 | 9.4 |
| 7:30 | 2,165 | 8.5 | 906 | 9.9 | 3,071 | 8.9 | 15 | 8.3 |
| 7:35 | 1,881 | 7.4 | 527 | 5.8 | 2,408 | 6.9 | 6 | 3.3 |
| 7:40 | 1,764 | 6.9 | 531 | 5.8 | 2,295 | 6.6 | 8 | 4.4 |
| 7:45 | 1,724 | 6.8 | 452 | 5.0 | 2,176 | 6.3 | 10 | 5.5 |
| 7:50 | 1,795 | 7.0 | 307 | 3.4 | 2,102 | 6.1 | 7 | 3.9 |
| 7:55 | 1,804 | 7.1 | 480 | 5.3 | 2,284 | 6.6 | 8 | 4.4 |
| 8:00 | 1,638 | 6.4 | 397 | 4.4 | 2,035 | 5.9 | 3 | 1.7 |
| Total | 25,538 | | 9,120 | | 34,658 | 100.0 | 181 | 100.0 |

Table 4. Comparison of results using different expansion methods for sockeye salmon at Chignik River weir, 1992.

| | Date | Actual | -----Methods---- Old 6 Times 10 Min. Count | New Linear Rate | Old Method Difference from Actual (Percent) | New Method Difference from Actual (Percent) |
|---|---|---|---|---|---|---|
| Gate 1 | 6/16 | 1,741 | 2,628 | 1,759 | 50.9 | 1.0 |
| | 6/18 | 23 | 108 | 29 | 369.6 | 26.1 |
| | 6/19 | 23 | 66 | 29 | 187.0 | 26.1 |
| | 6/20 | 21 | 66 | 24 | 214.3 | 14.3 |
| | 6/21 | 1,359 | 1,440 | 1,043 | 6.0 | -23.3 |
| | 6/22 | 2,333 | 2,478 | 2,223 | 6.2 | -4.7 |
| | 6/23 | 3,454 | 3,450 | 3,044 | -0.1 | -11.9 |
| | 6/24 | 4,393 | 5,412 | 4,330 | 23.2 | -1.4 |
| | 6/25 | 3,392 | 5,016 | 3,330 | 47.9 | -1.8 |
| | 6/26 | 27 | 114 | 30 | 322.2 | 11.1 |
| | 6/28 | 8 | 24 | 11 | 200.0 | 37.5 |
| | 6/29 | 21 | 66 | 28 | 214.3 | 33.3 |
| | 6/30 | 24 | 42 | 34 | 75.0 | 41.7 |
| | 7/1 | 38 | 138 | 46 | 263.2 | 21.1 |
| | 7/2 | 11 | 24 | 17 | 118.2 | 54.5 |
| | 7/3 | 60 | 60 | 53 | 0.0 | -11.7 |
| | 7/5 | 5 | 24 | 7 | 380.0 | 40.0 |
| | 7/13 | 597 | 804 | 624 | 34.7 | 4.5 |
| | 7/14 | 482 | 1,350 | 555 | 180.1 | 15.1 |
| | 7/15 | 426 | 1,020 | 569 | 139.4 | 33.6 |
| | 7/16 | 1,254 | 1,866 | 1,265 | 48.8 | 0.9 |
| | 7/17 | 1,262 | 1,068 | 1,011 | -15.4 | -19.9 |
| | 7/18 | 1,870 | 2,256 | 1,921 | 20.6 | 2.7 |
| | 7/19 | 1,154 | 1,752 | 1,197 | 51.8 | 3.7 |
| | 7/20 | 151 | 420 | 177 | 178.1 | 17.2 |
| | 7/21 | 672 | 1,314 | 568 | 95.5 | -15.5 |
| | 7/22 | 737 | 810 | 895 | 9.9 | 21.4 |
| Gate 2 | 7/24 | 2,391 | 3,438 | 2,393 | 43.8 | 0.1 |
| | 7/25 | 1,718 | 1,752 | 1,717 | 2.0 | -0.1 |
| | 7/26 | 892 | 1,740 | 841 | 95.1 | -5.7 |
| | 7/27 | 1,193 | 1,626 | 1,246 | 36.3 | 4.4 |
| | 7/28 | 532 | 960 | 533 | 80.5 | 0.2 |
| | 7/29 | 907 | 1,536 | 965 | 69.3 | 6.4 |
| | 7/30 | 945 | 1,764 | 984 | 86.7 | 4.1 |
| | 7/31 | 168 | 216 | 140 | 28.6 | -16.7 |
| | 8/1 | 96 | 18 | 83 | -81.3 | -13.5 |
| | 8/2 | 124 | 114 | 109 | -8.1 | -12.1 |
| | 8/3 | 154 | 258 | 171 | 67.5 | 11.0 |
| Both Gates | | 34,658 | 47,238 | 34,001 | 36.3 | -1.9 |
| Gate 1 | | 26,165 | 33,816 | 24,819 | 29.2 | -5.1 |
| Gate 2 | | 9,120 | 13,422 | 9,182 | 47.2 | 0.7 |

Table 5. Comparison of results using different expansion methods for chinook salmon at the Chignik River weir, 1992.

| Date | Actual | ----Methods---- Old 6 Times 10 Min. Count | New Linear Rate | Old Method Difference From Actual (Percent) | New Method Difference From Actual (Percent) |
|---|---|---|---|---|---|
| 7/18 | 24 | 42 | 20 | 75.0 | -16.7 |
| 7/19 | 4 | 12 | 10 | 200.0 | 150.0 |
| 7/22 | 5 | 12 | 4 | 140.0 | -20.0 |
| 7/21 | 12 | 42 | 13 | 250.0 | 8.3 |
| 7/24 | 44 | 60 | 38 | 36.4 | -13.6 |
| 7/26 | 26 | 30 | 27 | 15.4 | 3.8 |
| 7/27 | 21 | 36 | 22 | 71.4 | 4.8 |
| 7/28 | 7 | 18 | 9 | 157.1 | 28.6 |
| 7/29 | 15 | 36 | 12 | 140.0 | -20.0 |
| 7/30 | 5 | 24 | 5 | 380.0 | 0.0 |
| 7/31 | 9 | 24 | 12 | 166.7 | 33.3 |
| 8/1 | 4 | 12 | 6 | 200.0 | 50.0 |
| 8/3 | 5 | 12 | 4 | 140.0 | -20.0 |
| | 181 | 360 | 182 | 98.9 | 0.6 |

Table 6. Comparison of two methods that estimate actual counts of sockeye salmon within the first hour from counting samples, and expansion of the error associated with each method from the sample to the entire season.

| Methodology | #Sockeye |
|---|---|
| **Old Method** | |
| **Expansion From The Sampled Gate To The Unsampled For Each Sample Day (n=38)** | |
| (Old Method - Actual) (n= 38 Samples) | 12,580 |
| Estimated Counts For One Gate on days Sampled | 248,629 |
| Estimated Count For Both Gates On Days Sampled | 593,403 |
| Expansion Proportion: $\frac{12,580}{x} = \frac{248,629}{593,403}$ | |
| Estimated Total Error On Days Sampled $x = 30,025$ | |
| **Adjustment For Second 10 Min Expansion** | |
| Percent Second 10 min less than First: 2.1% | |
| 30,025 - 12,580 = 17,445 | |
| 17,445 * 2.1% = 366 | |
| Adjustment: 17,445 - 368 = 17,079 | |
| 17,079 + 12,580 = 29,659 | |
| **Expansion From The Sampled Days To The Unsampled Days** | |
| Estimated Total Sockeye Escapement | 766,603 |
| Estimated Counts For Both Gates On Days Sampled | 593,403 |
| Total Difference on Sampled Days | 29,659 |
| Expansion Proportion: $\frac{29,659}{x} = \frac{593,403}{766,603}$ | |
| Estimated Total Error For Season $x = 38,316$ | |
| **New Method** | |
| **Expansion From The Sampled Gate To The Unsampled For Each Sample Day (n=38)** | |
| (New Method - Actual) (n=38 Samples) | -657 |
| Estimated Counts For One Gate on day Sampled | 248,629 |
| Estimated Count For Both Gates On Day Sampled | 593,403 |
| Expansion Proportion: $\frac{-657}{x} = \frac{248,629}{593,403}$ | |
| Estimated Total Error On Days Sampled $x = -1,568$ | |

-Continued-

Table 6. (page 2 of 2)

| Methodology | #Sockeye |
|---|---|
| **Expansion From The Sampled Days To The Unsampled Days** | |
| Estimated Total Sockeye Escapement | 766,603 |
| Estimated Counts For Both Gates On Days Sampled | 593,403 |
| Total Difference on Sampled Days | -1,568 |
| Expansion Proportion: $\frac{-1,568}{x} = \frac{593,403}{766,603}$ | |
| Estimated Total Error For Season $x = -2,026$ | |

Table 7. Comparison of the differences from actual and percent error[a] for two escapement estimates for the entire season for chinook and sockeye salmon, 1992.

| Method | Chinook | %Error | Sockeye | %Error |
|---|---|---|---|---|
| Old | 1,502 | 41.0 | 38,316 | 5.0 |
| New | 5 | 0.1 | -2,026 | -0.3 |

[a] Percent error:
Old Method = Old Method Error / Estimated Actual Escapement
New Method = New Method Error / Estimated Actual Escapement
Where Estimated Actual Escapement = New Method Escapement + Estimated Error Of New Method Estimate.

Table 8. Actual counts for chinook salmon at the gate sampled and total escapement for both gates within the first hour.

| Date | Sampled Gate Actual Count | Total Count Both Gates |
|---|---|---|
| 7/18 | 24 | 78 |
| 7/19 | 4 | 8 |
| 7/22 | 5 | 21 |
| 7/21 | 12 | 30 |
| 7/24 | 44 | 76 |
| 7/26 | 26 | 52 |
| 7/27 | 21 | 25 |
| 7/28 | 7 | 13 |
| 7/29 | 15 | 34 |
| 7/30 | 5 | 27 |
| 7/31 | 9 | 18 |
| 8/01 | 4 | 8 |
| 8/03 | 5 | 6 |
| Total | 181 | 396 |
| Percent Sampled Each Gate: | 181/396 = 46% | |

Table 9. Comparison of two methods that estimate actual counts of chinook and sockeye salmon within the first hour from counting samples, and expansion of the error associated with each method from the sample to the entire season.

| Methodology | #Chinook |
|---|---|
| **Old Method** | |
| **Expansion From The Sampled Gate To The Unsampled For Each Sample Day (n=13)** | |
| Old Method - Actual (n=13) | 179 |
| Probability king using a particular gate | 0.50 |
| Total count of Kings both gates (2*179) | 358 |
| Count Estimate For Both Gates On Days Sampled | 874 |
| Count Estimate For Both Gates Entire Season | 3,806 |
| Expansion Proportion: $\frac{358}{x} = \frac{874}{3,806}$ | |
| Estimated Total Error For Season: x = 1,559 | |
| **Adjustment For Second 10 Min Expansion:** | |
| Probability a king uses gate1 or gate2: 0.5 | |
| Percent Second 10 min less than First: 7.2 | |
| Second Gate Escapement: 1,559 * 0.5 = 779 | |
| Adjustment equals: 779 * .072 = 56 | |
| 779 - 56 = 723 | |
| Estimated Total Error For Season: 779 + 723 = 1,502 | |
| **New Method** | |
| Gate #1 | |
| Old Method Minus Actual | 1 |
| Count Estimate For Both Gates On Days Sampled | 874 |
| Count Estimate For Both Gates Entire Season | 3,806 |
| $\frac{1}{x} = \frac{874}{3,806}$ | |
| Estimated Total Error For Season: x = 5 | |

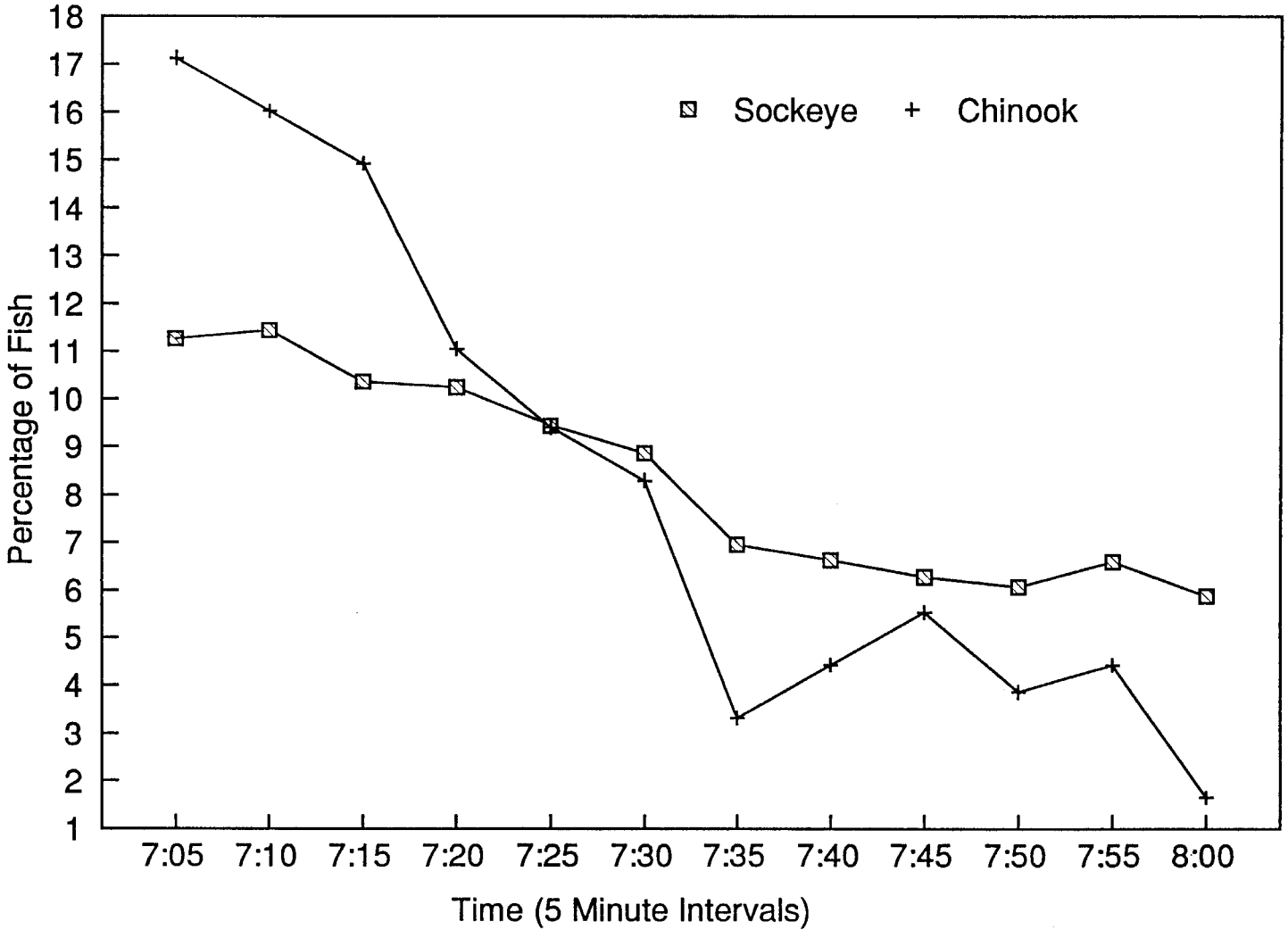


Figure 1. Percentage of actual escapement per time interval for chinook and sockeye salmon counted at the Chignik River weir, 1992.

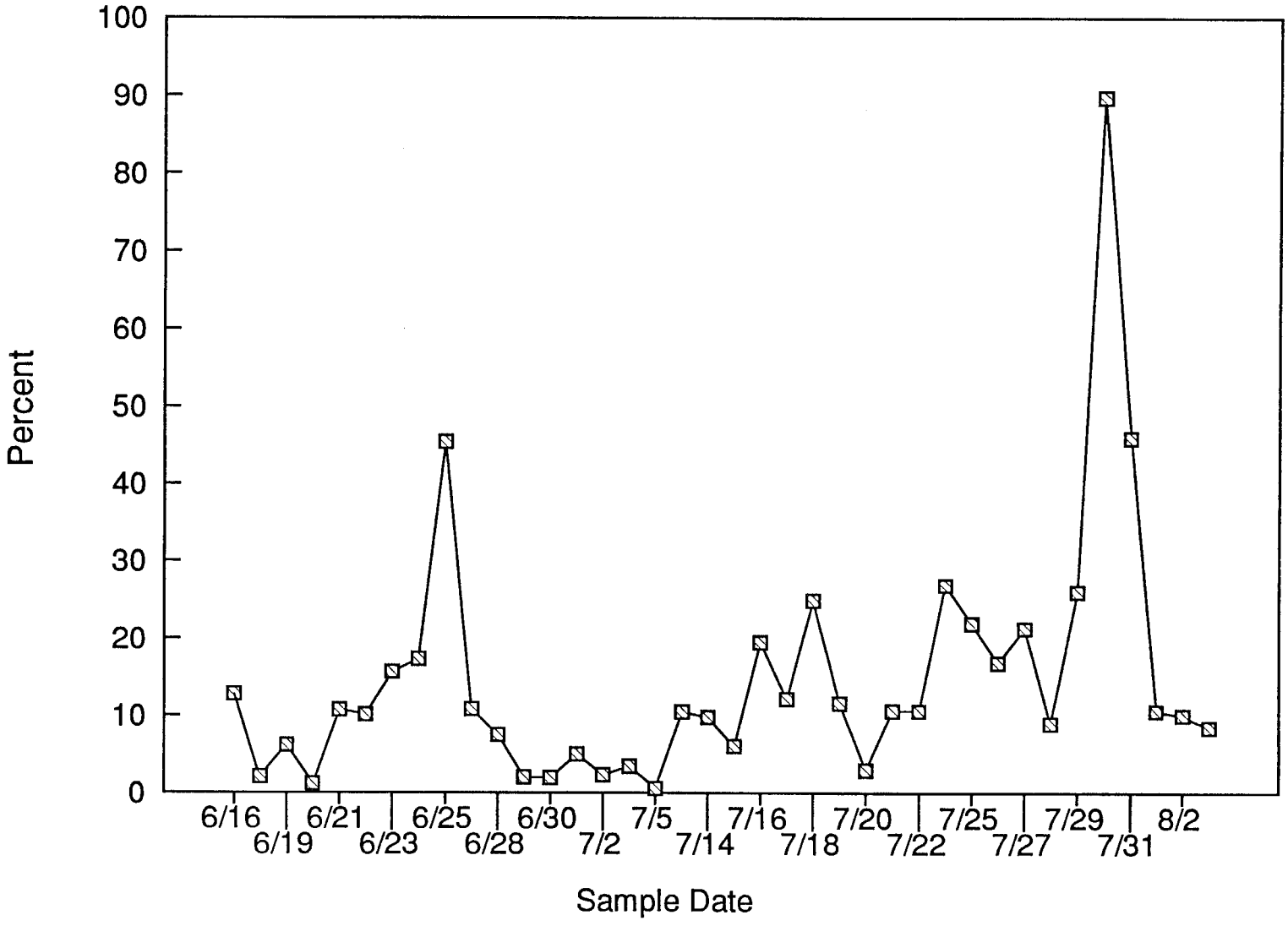


Figure 2. Percentage of the total daily sockeye salmon escapement counted in the first hour through the Chignik River weir, 1992.

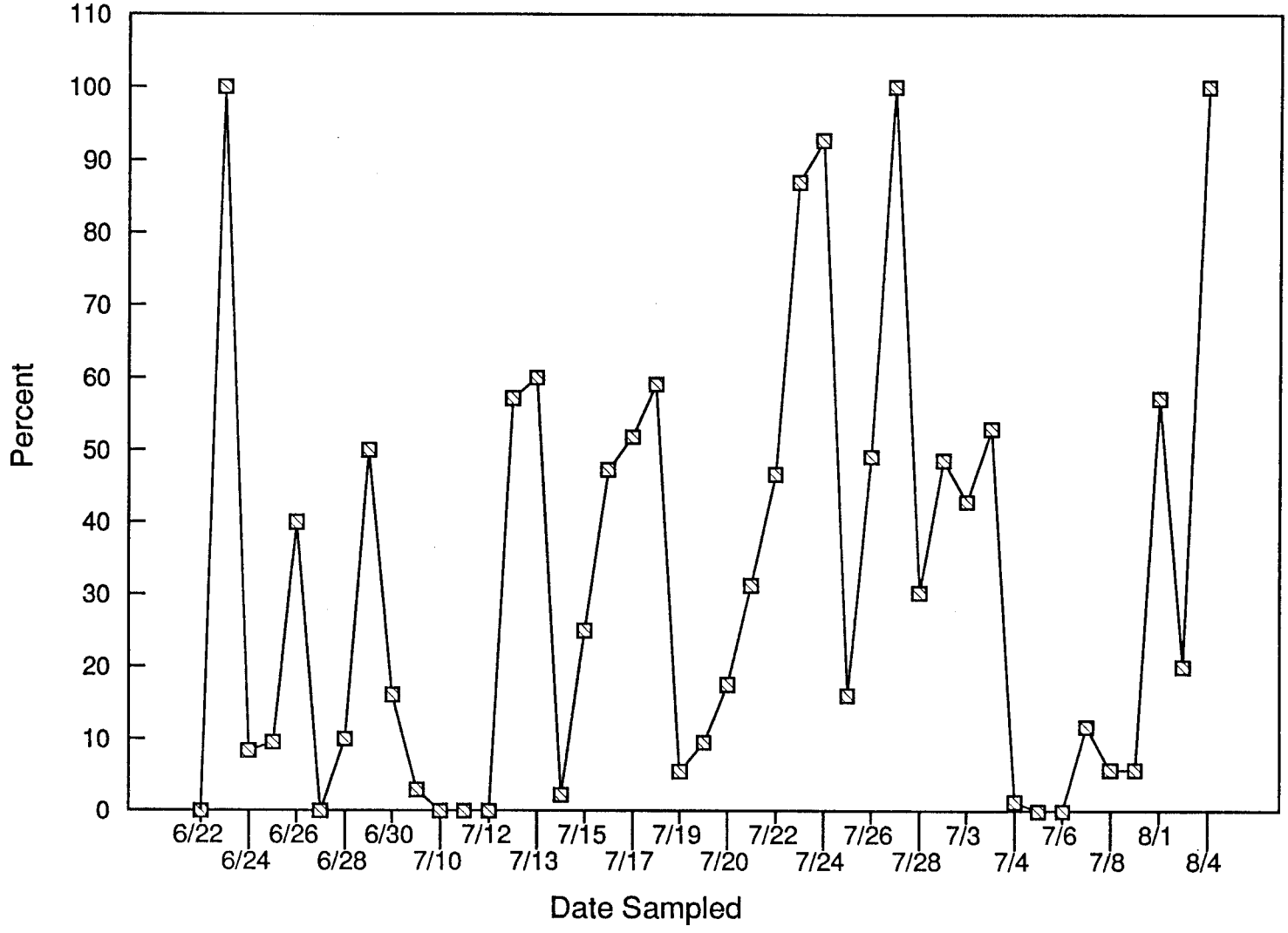


Figure 3. Percentage of the total daily chinook salmon escapement counted in the first hour through the Chignik River weir, 1992.

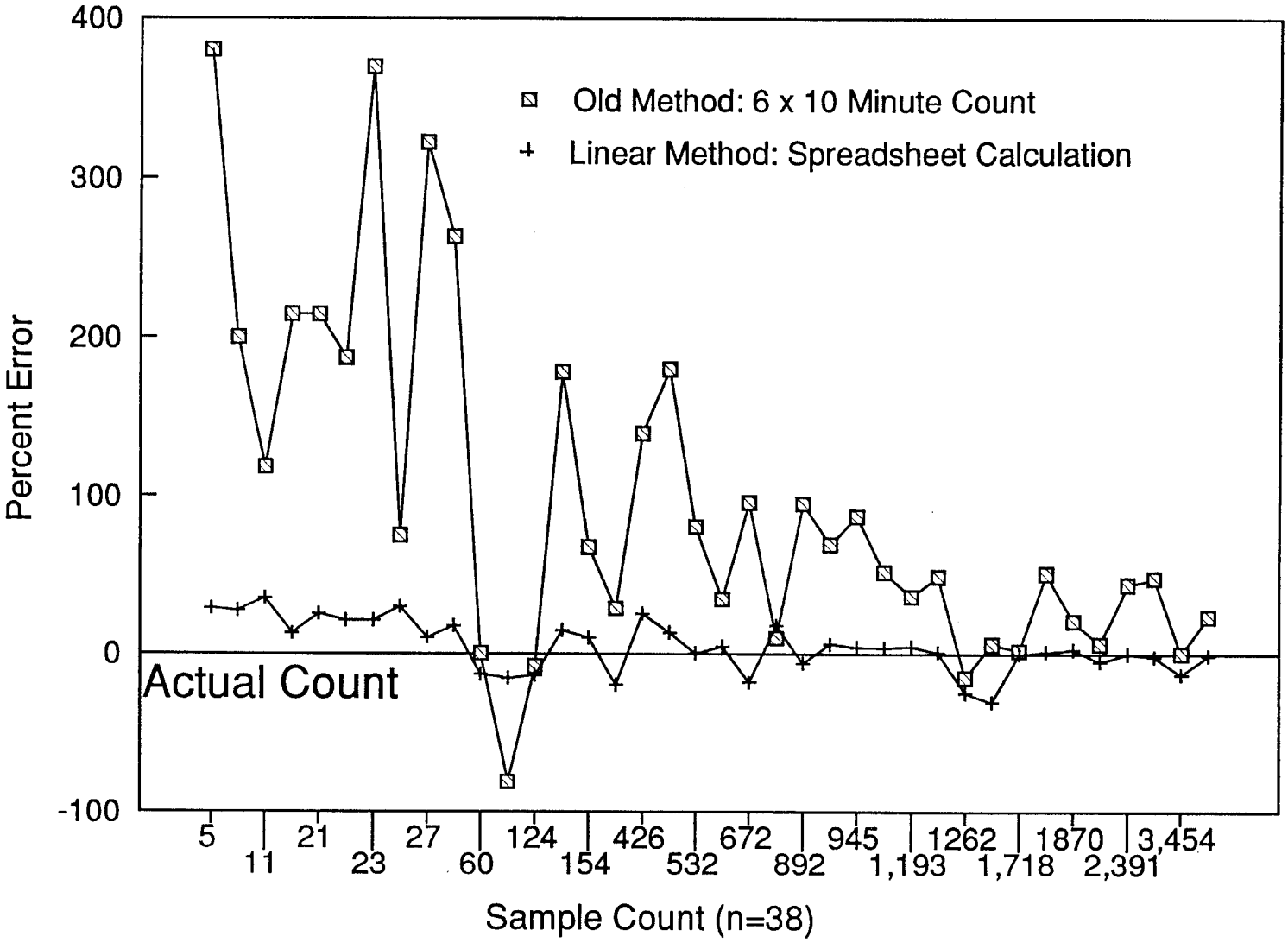


Figure 4. Comparison of the percent error associated with two methods of estimating sockeye salmon escapement (7:00 - 8:00 am) at the Chignik River weir, 1992.

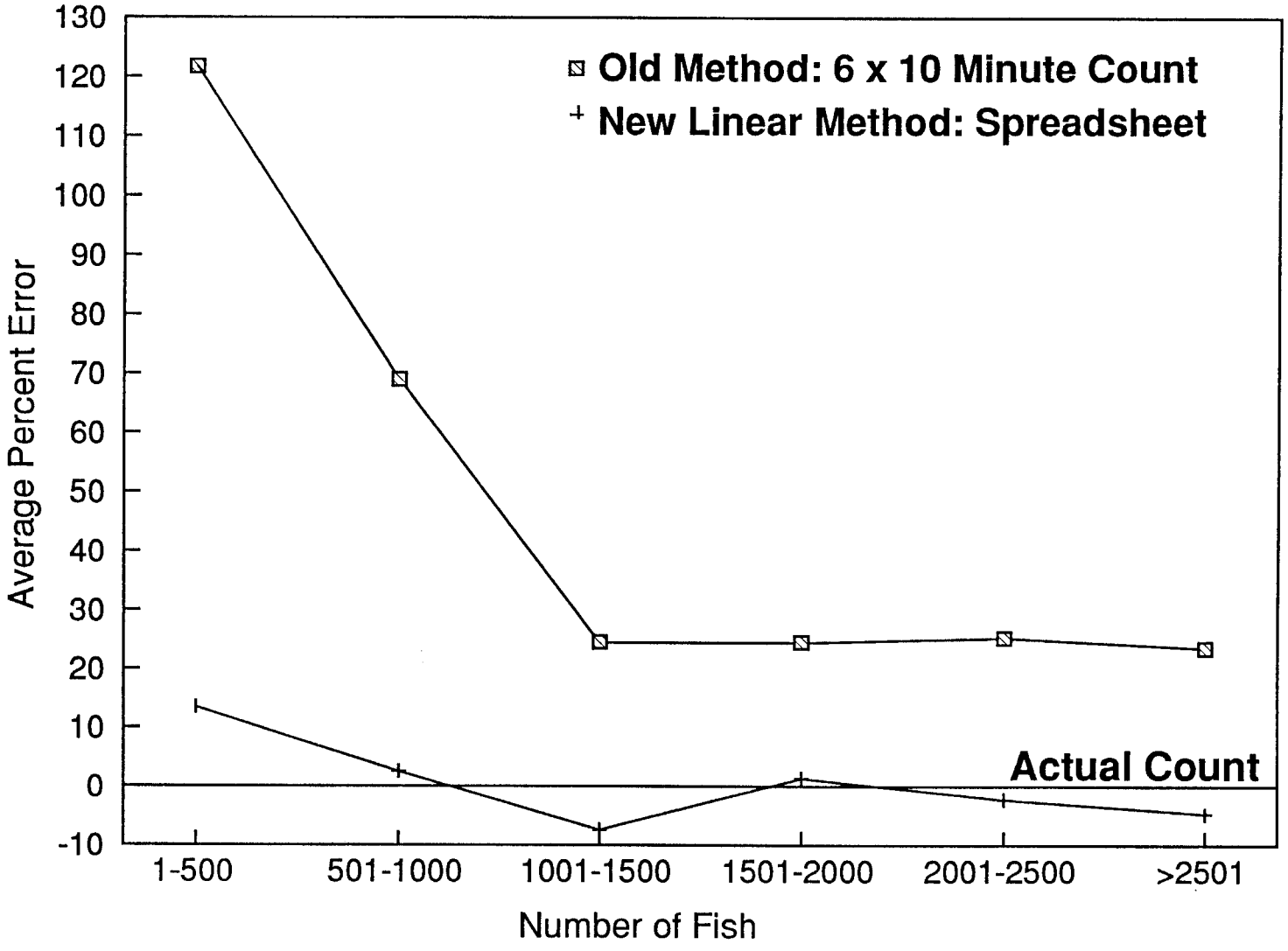


Figure 5. Comparison of average percent error for each estimation method grouped by number of sockeye salmon at the Chignik River weir, 1992.

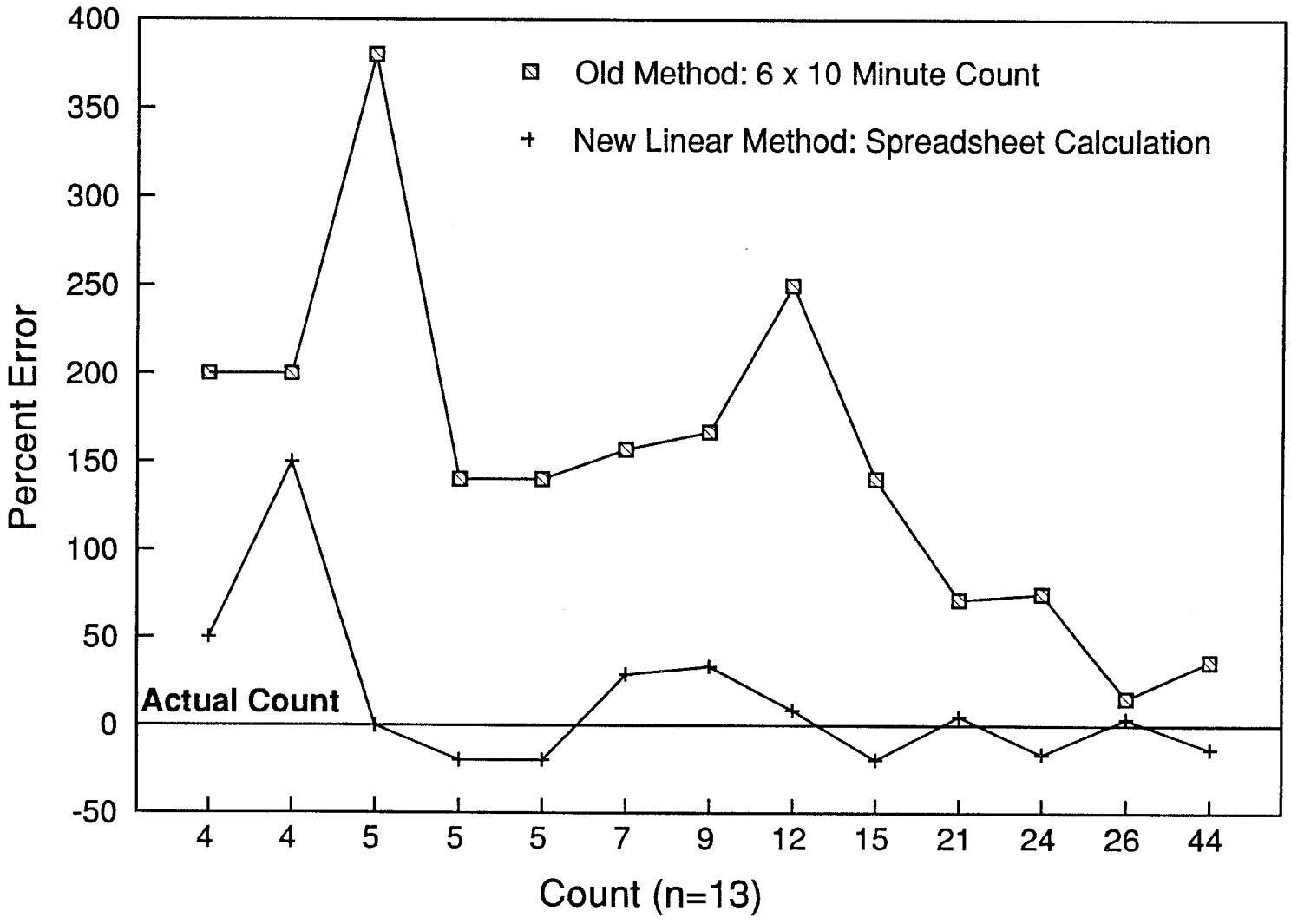


Figure 6. Comparison of the percent error associated with two methods of estimating chinook salmon escapement (7:00 - 8:00 am) at the Chignik River weir, 1992.

# APPENDIX

Appendix A.1. Timed sockeye salmon counts by gate and estimated total escapement by hour and gate, Chignik River weir, 1992.

| | GATE 1 | | | | GATE 2 | | | | TOTAL CHIGNIK WEIR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Time | Hour | COUNT Period | Count | Est. Total Hour | Hour | Count Period | Count | Est. Total Hour | Hour | Est. Total Hour | Daily Cum. |
| 7am | 1 | 0-20<br>30-40 | | 0 | 1 | 0-20<br>30-40 | | 0 | 1 | 0 | 0 |
| 8am | 2 | 0-10 | | 0 | 2 | 10-20 | | 0 | 2 | 0 | 0 |
| 9am | 3 | 0-10 | | 0 | 3 | 10-20 | | 0 | 3 | 0 | 0 |
| 10am | 4 | 0-10 | | 0 | 4 | 10-20 | | 0 | 4 | 0 | 0 |
| 11am | 5 | 0-10 | | 0 | 5 | 10-20 | | 0 | 5 | 0 | 0 |
| noon | 6 | 0-10 | | 0 | 6 | 10-20 | | 0 | 6 | 0 | 0 |
| 1pm | 7 | 0-10 | | 0 | 7 | 10-20 | | 0 | 7 | 0 | 0 |
| 2pm | 8 | 0-10 | | 0 | 8 | 10-20 | | 0 | 8 | 0 | 0 |
| 3pm | 9 | 0-10 | | 0 | 9 | 10-20 | | 0 | 9 | 0 | 0 |
| 4pm | 10 | 0-10 | | 0 | 10 | 10-20 | | 0 | 10 | 0 | 0 |
| 5pm | 11 | 0-10 | | 0 | 11 | 10-20 | | 0 | 11 | 0 | 0 |
| 6pm | 12 | 0-10 | | 0 | 12 | 10-20 | | 0 | 12 | 0 | 0 |
| 7pm | 13 | 0-10 | | 0 | 13 | 10-20 | | 0 | 13 | 0 | 0 |
| 8pm | 14 | 0-10 | | 0 | 14 | 10-20 | | 0 | 14 | 0 | 0 |
| 9pm | 15 | 0-10 | | 0 | 15 | 10-20 | | 0 | 15 | 0 | 0 |